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STAR CLUSTERS AND THE ORIGIN OF STARS

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/A Digest/

Our Galaxy contains, besides the numerous twins and triplets, other stellar associations called star clusters, which are composed of many stars forming as it were "collective members" of the Galaxy. These clusters are divided into two types: open and spherical.

An open cluster is less dense in that the number of stars in it per unit volume is comparatively small. Ordinarily, the cluster consists of several score, at most several hundreds, of members; they rotate around the Galaxy's plane of symmetry. They are composed mainly of stars of comparatively high brightness, with very few dwarfs.

Spherical star clusters differ sharply from open ones, each one of them consisting of tens of thousands, possibly even hundreds of thousands of stars, and having an orbit round the Galaxy's center that diverges strongly from a circular one. In their orbits they can move great distances, sometimes 1,000 parsecs, from the Galaxy's plane of symmetry. Spherical clusters are very rich in stars of low brightness and do not contain hot super giants at all (as P. P. Parenko has discovered, they also contain many dwarfs and, probably, subdwarfs).

Clusters of one or the other type are always distinguished sharply in the background of the Galactic field as strong stellar concentrations, in spite of their great diversities among them. On photographs they always appear as very remarkable "star clumps."

The nonhomogeneous gravitational field in the Galaxy tends to expand and disrupt star clusters, since the member stars undergo varying accelerations. This action of the Galaxy on clusters is just like the tidal action of the sun on the earth, and hence can be called tidal.

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If this "tidal force" exceeds the attraction between the stars of a cluster, then it should slowly begin to break up. It is easy to calculate the tidal forces that exceed the internal forces, which will be when the average density of the cluster becomes lower than a certain critical density of the order of the mean Galactic density. This means that, in order for cluster to break up, its density must have been made lower than the density of the whole Galactic stellar field. Hence it would seem that such a cluster could not exist. Moreover, stars of such clusters should be lost in the background, because of their lower density and difficulty to observe in photographs. Until recently the question of the possible existence of such low-density systems had not been raised.

In 1947 Soviet astronomers noted several facts appearing in observations:

Amont the myriads of known variable stars are several thousand stars that belong to Type T Taurus, differing irregularly in variation of brightness and showing bright lines in their spectra. They belong to a number of dwarfs of spectral types G-K-M. It seems that T stars are not scattered uniformly in the sky. Among stars of this type two groups of stars are especially distinguished: one in Taurus -- Auriga, and the other in Aquila -- Ophiuchos.

Knowing the distances between the stars in these groups, one can evaluate the diameter and density of the groups. This density turned out to be hundreds of times less than that of the Galactic field. Therefore, these groups cannot be numbered among the ordinary star clusters; they were named T-associations. Later star-dwarfs (spectral types G-K-M with bright lines) were found in the same portions of the sky and are to be included in T-associations. Obviously such systems cannot exist long and must rapidly break up after their creation. These T-associations have been actually observed.

Also, great interest is shown in scattered groups of stars of spectral types O and B, namely, hot supergiants -- forming so-called O-associations.

/Similarly, there are other associations: A, B_0, B_1, B_5, etc./

Conclusions

It must be assumed that stars forming T and O-associations are very young, since star clusters have such short existences (10-20 million years). The fundamental conclusion is that the formation of stars is continuing in our Galaxy and in our epoch. Another important conclusion is that stars are created in clusters or associations.

The growth of stars is small in comparison with the relaxation time; therefore, the influence of proximity of stars can be disregarded in the life time of stars, and spatial distributions do not vary with time. Thus open clusters do not transform into spherical ones and vice versa. In other words, stars in a certain subsystem cannot be in a different stage of development.

In the neighborhood of our sun (3,000 parsecs radius) there are 20 O-associations and hence probably 1,000 in our Galaxy. Their lifetime is about 10 million years.

Stars originating in our Galaxy appear in Russell's diagram at various portions of the main sequence.

Astronomers of the West often display inability and ineptness in their attempts at cosmogonic interpretation of the results of astrophysical observations.

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